CORPS OF ENGINEERS, U. S. ARMY

FIELD PERMEABILITY TESTS
COMMERCE LANDING, MISSISSIPPI, AND
WILSON POINT, LOUISIANA

TECHNICAL MEMORANDUM NO. 3-299

WATERWAYS EXPERIMENT STATION

VICKSBURG, MISSISSIPPI

AUGUST 1949

Report Documentation Page

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MRC-WES-75

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Preface

The investigation reported herein was authorized by the Mississippi River Commission in 1943 and was initiated in the fall of 1943 and completed in the spring of 1944. The study was performed by the Embankment and Foundation Branch of the Soils Division, Waterways Experiment Station. Engineers actively connected with the study were Messrs. W. J. Turnbull, W. H. Jervis, J. B. Eustis, T. B. Goode, and C. C. Mumm. This report was prepared by Messrs. W. J. Emrich and C. I. Mansur.

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FIELD PERMEABILITY TESTS

COMMERCE LANDING, MISSISSIPPI, AND WILSON POINT, LOUISIANA

Introduction

1. Observations made during the high water of June 1943 on the performance of relief wells installed along the levees at Commerce Landing and Trotters, Mississippi, and at Wilson Point, Louisiana, revealed that flow from the wells was greater than anticipated in the original design of the systems. This increased flow was attributed to a more pervious foundation and/or to a closer seepage entrance on the riverside of levee than was assumed in the design. Although the depth of the pervious foundation also affects the well flow, it was fairly accurately known from previous boring explorations. Because of the importance of the quantity of flow in the design of a well system, Thiem-type field permeability tests were conducted at Commerce Landing and Wilson Point for the purpose of more accurately determining the over-all permeability of the pervious stratum. These tests were initiated in the fall of 1943 and were completed in the spring of 1944. This report covers only the field permeability tests; information on the well installations at Commerce Landing and Wilson Point is given in a report to be published by the Waterways Experiment Station in the fall of 1949 entitled "Underseepage Investigation -- Commerce, Mississippi," and a report issued by the Vicksburg District, CE, in August 1943 entitled "Report on Wilson Point Seepage Test Installation."

2. Since the pervious sands in the alluvial valley of the

Mississippi River become coarser with depth, the pumping tests were run at various penetrations of the pervious stratum in order to determine the change in permeability with depth. Penetrations to be tested were 100, 75, 50, and 25 per cent of the depth of pervious stratum. The pumping test at Commerce Landing was started in November 1943 and the test for 100 per cent penetration was completed at that time. The 75 per cent penetration test was begun, but it was decided to wait until the water table was higher before completing this test or starting the 50 and 25 per cent penetration tests. The tests at Wilson Point were made during January and February 1944 for 100, 75, and 50 per cent penetrations. The equipment was then moved to Commerce Landing to complete the testing program there.

3. Bad weather conditions made it undesirable to run the tests at Trotters, Miss., at the time the tests at the other sites were completed. Later, upon study of the results of the two completed tests, it was considered unnecessary to perform the tests at Trotters.

Commerce Landing Site and Tests

Location and soil conditions

4. The site of the pumping tests at Commerce Landing is located in the floodplain of the Mississippi River in the northern part of Tunica County, Miss. (see vicinity map on plate 1). Heavy underseepage and numerous sand boils had occurred landward of the levee at this site during the 1937 high water. The alluvial sediments within this area may be divided into two main divisions; a relatively impervious top stratum with materials ranging from clay to sandy silt, and a pervious substratum of

sands and gravels. The top stratum varied in thickness from 3 to 10 ft with an average thickness of about 6 ft. Samples from the test-well boring indicated impervious Tertiary materials at a depth of about 190 ft. The locations of borings made by the Memphis District, CE, in connection with an underseepage study and piezometer installation at this location are shown on plate 1; plate 3 presents the logs of these borings. A more detailed discussion of the geological features and of the underseepage study and piezometer installations mentioned above is contained in the report referred to in paragraph 1 entitled "Underseepage Investigation -- Commerce, Mississippi."

5. The test-well boring, CL-2, was located 325 ft landside of the levee at station 23/2+75 in the line of the pressure relief wells which had been installed in December 1942 and January 1943. Two lines of piezometers intersecting at right angles were installed at the location of the test well to determine the elevation of the water table and drawdown during the pumping tests. Existing wells and piezometers were also utilized in the lines of observation piezometers when their location permitted. The piezometers or observation wells were spaced at equal distances of 12.5, 25, 50, 175, 275, and 375 ft from the test well (see plate 1). Observations were made of other piezometers located beyond the influence of the drawdown caused by the pumping of the well in order to ascertain the elevation of the ground-water table. The log of the test-well boring also appears on plate 3.

6. Grain-size curves of typical samples from the test-well boring are shown on plate 5. From these curves it is apparent that the coarseness of the substratum materials definitely increased with depth.

Description of installation

7. Test well. The well screen consisted of 4-in. I.D. (6-in. O.D.) porous concrete pipe which was placed to within 3 ft of the impervious Tertiary deposits. This gave the well screen a total length of 158 ft. Twenty feet of 5-in. riser pipe was placed on top of the well screen. The screen and riser pipe were installed inside an 8-in. casing. No filter was placed around the porous concrete pipe.

8. Pumps. The water table at the time of the installation of the pumps was about 22 ft below the ground surface. Therefore, the pumps were installed in a pit 11 ft deep thereby reducing the suction head at the pump intake to 13 ft. A Fairbanks-Morse centrifugal pump powered with a 6-cylinder industrial Chrysler motor and rated at 750 gpm at 1400 rpm was used in the pumping test. A foot valve was installed in the bottom of the 5-in. riser pipe to aid in priming the Fairbanks-Morse pump. The suction and discharge ends of this pump were 4 in. in diameter. A Jaeger centrifugal pump powered with a 4-cylinder, V-type Wisconsin motor and rated at 500 gpm was installed for use in case the large pump proved inadequate. The intake and discharge pipes of this pump were also 4 in. in diameter.

9. These pumps were attached to the well with a double 5-in. "T" arrangement so as to give the shortest possible hookup to the well. A 4-in. gate valve was installed between the well and each pump to facilitate priming and to eliminate air leaks when not in use. The pumps had an intake elevation of 189.77 mgl and a discharge elevation of 200.92 mgl which resulted in a discharge head of 11.15 ft. The discharges of the pumps were connected with a 5-in. "T" after which the water was forced through

a 5-in. Spaulding water meter, placed 5 ft from the junction of the discharges. From the water meter, flow passed into a weir box 5 ft long by 3 ft wide by 3 ft deep, and on into the collection ditch for the relief wells.

10. Meters. It was found during the operation of the Jaeger pump that the meter readings were too high compared to flow observations determined from weir box readings. These high meter readings were attributed to an air leak around the grease seal of the packing gland. Therefore, the weir box readings were used with the Jaeger pump to obtain discharge data. The meter was used to record flow data when the Fairbanks-Morse pump was being used and when the capacity of the weir box was exceeded.

Testing

11. The well was pumped at each penetration until a steady flow was obtained. At this time the final flow measurements were made and all of the piezometers read. Daily observations were made after pumping was started to check the level of the water table throughout the test. On the last day of each test, observations of the piezometers and wells were made at three-hour intervals within a 50-ft radius of the pumped well to detect any change in the slope of the water table. Readings of the river gage were taken each day to determine the over-all gradient toward the river as pumping progressed.

12. Backfill and pumping difficulties. During November 1943 the well was pumped for the 100 per cent penetration and then backfilled with sand, topped with 1 ft of tamped clay, to the computed 75 per cent well penetration depth. During the tamping process the tamping shoe became

jammed in the well, and, as a result, it and 10 ft of 3/4-in. pipe had to be left in the well.

13. In February 1944 the 75 per cent penetration test was run on the well. After completion of this test, the well was backfilled with sand to 50 per cent penetration. After pumping the 50 per cent well for one hour at a rate of approximately 150 gpm to flush it, the discharge rate was increased to about 400 gpm, and held at this rate for 18 hours. Inasmuch as some sand was pumped out during this operation, a check of the backfill was made at the completion of the test. It was found that the backfill had been lost to a depth of 2 ft below the 50 per cent penetration level, which meant that this test had actually been performed for a penetration of 53 per cent. The well was then backfilled to 4 ft above the 25 per cent penetration level with sand and topped with 1-1/2 ft of 3/4 in. to No. 4 gravel filter to aid in preventing outwash of the backfill sand. The 25 per cent penetration test was completed at a pumping rate of 135 gpm. Again the depth was checked and it was found that 12 ft of backfill had been lost, thus giving an actual penetration of about 30 per cent.

14. Pumping difficulties were experienced during the entire testing procedure. Due to pump breakdowns, continuous pumping was not possible. The rate of pumping was also less than desired and the rate of flow was not completely constant at all times. Although these difficulties contributed to the work involved in performing the tests, they did not adversely affect the technical information obtained to any considerable extent.

Wilson Point Site and Tests

Location and soil conditions

15. The site of the pumping test at Wilson Point is located in northern Louisiana in a point of land lying between Old River on the west, the Mississippi River on the east, and Opossum Chute (now an active channel of the Mississippi River) on the north (see vicinity map on plate 2). As was the case at Commerce Landing, this site had shown heavy underseepage and sand boils during the 1937 high water. The Vicksburg District in 1942 undertook an underseepage investigation of this area which included an extensive system of piezometers and pressure relief wells. The results of this study were published by that office in August 1943 under the title "Report on Wilson Point Seepage Test Installation."

16. The geological conditions of this area are similar to those found at Commerce Landing. The top stratum has a minimum thickness of about 9 ft and an average thickness of approximately 12 ft. The sediments in the top stratum consist of materials ranging from clays to silty sands, and include some local lenticular sand bodies. Within an effective radius of the test well, the depth to the bottom of the substratum varies from 150 to 180 ft, where it is underlain by impermeable Tertiary deposits. The grain-size curves appearing on plate 6 generally indicate an increasing coarseness of the pervious materials with depth. This fact would suggest that the permeability of the deeper sands and gravels would be greater than for those pervious materials found at shallow depths. A detailed study of the geological conditions at this site is presented in a report by Dr. H. N. Fisk entitled "Geological Report on Wilson Point

Underseepage Area." The locations and logs of borings made by the Vicksburg District in connection with the underseepage investigation mentioned in the preceding paragraph appear on plates 2 and 4, respectively.

17. The test well was located approximately 200 ft landside of the center line of the levee at station 852 and was placed so as to make use of the existing line of pressure relief wells and piezometers for observation readings. On lines running nearly at right angles through the test well, 36 piezometers and wells were spaced at radial distances of 12.5, 25, 50, 75, 125, 175, 275, 375, and 525 ft from the test well (see plate 2). Other piezometers at greater distances from the test well were read in order to determine the elevation of the ground-water table throughout the test. The log of the test-well boring is shown on plate 4.

Description of installation

18. Test well. The test well, which penetrated through the pervious stratum to a depth of 177 ft below ground level, consisted of 150 ft of 4-in. I.D. porous concrete pipe and 26 ft of 5-in. riser pipe. The upper 5 ft of the riser pipe, which was in two sections, was removed and the ground around it was excavated to form a pit 10 ft by 12 ft by 7 ft deep in which two pumps were installed.

19. Pumps. The pumps used for this test were the same ones used at Commerce Landing; a Fairbanks-Morse and a Jaeger, the latter being used as an auxiliary pump.

20. Meters. The two discharge pipes were connected to one 5-in. discharge line that was 7 ft above the pump intake. The water in the discharge pipe was forced through a 5-in. Spaulding meter and on to the

collection ditch for the pressure relief wells. The meter was placed 5 ft from the entrance of the second pump into the discharge line to minimize turbulence of the flow before it entered the meter.

Testing

21. The testing procedure was the same as that followed at Commerce Landing.

22. Backfilling and pumping difficulties. After the 100 per cent penetration test was completed, the well was backfilled with medium to coarse sand to the computed 75 per cent penetration depth and repumped. Upon checking the depth of the well after completion of the test it was found that 2 ft of backfill had been lost, increasing the actual penetration to approximately 76 per cent. As a result of this observation, the backfill for the 50 per cent penetration was purposely increased one foot more than necessary to allow for possible loss during the test. At the end of this test, it was found that a loss of 33 ft of backfill had occurred during pumping, which increased the actual penetration depth to about 71 per cent. In view of this severe loss the well was backfilled to 3 ft more than necessary for the 25 per cent penetration test, the upper 1-1/2 ft consisting of pea gravel. Operation of the pump for this penetration failed to bring enough water up to keep the pump primed.

Computations and Test Results

Method of computation

23. Thiem's formula for a steady state of gravity flow to a well, as modified by Muskat for partially penetrating wells, was used for

computing the field coefficients of permeability at the sites tested.

$$k = \frac{0.156\ Q\ C\ \log_{10} \frac{r_2}{r_1}}{\pi (h_2^2 - h_1^2)} \text{ in cm per sec} \quad . . . . (1)$$

where Q = well flow in gallons per minute,

C = correction factor for partial penetration (dimensionless),

r_1 and r_2 = radial distance from test well to observation wells in feet, and

h_1 and h_2 = average water heads at observation wells measured from bottom of test well at each per cent penetration in feet.

The results of the pumping tests are summarized in tables 1 and 2. The values shown are the average permeability coefficients as determined from all combinations of differences in head at various radii from the test well. The h-value at any given radius was taken as the average of four observations, all of which were in lines radial to the test well. Final drawdown curves from which these water heads were taken are shown on plates 7-9. Correction factors for partial penetration as derived by Muskat* and shown graphically on plate 10 were used in the preceding formula for computing the foundation permeability.

Results of tests

24. A study of the test results shown in tables 1 and 2 indicates a tendency for the computed coefficient of permeability to decrease with

* Morris Muskat, "The Flow of Homogeneous Fluids through Porous Media," (New York; McGraw-Hill Book Co.: 1937), pp 96 and 384.

depth of penetration into the pervious stratum. This tendency may be incorrect, because visual classifications and mechanical analyses of the samples obtained from the test wells and other borings show, in general, a progressive increase in coarseness with depth. There is a good correlation between the effective grain sizes (D_{10}) and the laboratory-determined coefficients of permeability on disturbed samples of the granular materials found within the alluvial valley of the Mississippi River. This relation is shown on plate 11, the data being taken from tests performed on samples obtained at various sites along the Mississippi River. Coefficients of permeability obtained from this graph are shown adjacent to the logs of the test well borings on plates 3 and 4. A comparison of permeabilities for various penetrations as determined from both the field tests and the empirical curve on plate 11 is given in table 3 for the wells at Commerce Landing and Wilson Point.

Discussion of test results

25. It may be noted from table 3 that the permeabilities determined from effective grain sizes (plate 11) indicate some increase in permeability of the foundation with depth, whereas the in situ field tests show some decrease of permeability with depth. No positive data are available to indicate the correctness or incorrectness of the permeability results as determined by the two methods. Permeability values determined from effective grain sizes are influenced by such factors as sample disturbance, gradation, shape of grains, and void ratios, all of which affect the accuracy of the computed values. On the other hand, permeability values obtained from partially penetrating well pumping tests are influenced by

stratification and change of permeability with depth. The important consideration is that the average permeability of the entire pervious stratum as determined by the 100 per cent penetration pumping tests and the laboratory tests agrees quite closely at both sites. There is, thus, an indication that at sites similar to those tested permeabilities obtained in the laboratory can be applied to field problems with assurance that large errors are not involved.

26. If it is assumed that the pervious stratum increases in permeability with depth, rather than decreasing as indicated by the field pumping tests, the permeabilities computed from equation (1) for the partially penetrating pumping tests would be too high. This may be explained from a consideration of Muskat's correction factor, C, as used in Thiem's formula. This correction factor, as derived by Muskat for partially penetrating wells, is based on the assumption that the pervious stratum is homogeneous. Where the lower strata of a pervious foundation are more permeable than the upper strata, a condition ordinarily assumed to exist in the Lower Mississippi River Valley, the correction factors as obtained from plate 10 for partially penetrating wells are somewhat high, as explained below, and thus result in a computed permeability for partially penetrating wells greater than the actual permeability in the field. Where the sand strata in a foundation are more pervious with depth, the "effective" penetration of partially penetrating wells is less than the numerical ratio of well screen length below the water table to total saturated depth of sand strata. Thus, C-values obtained from plate 10 using the above numerical ratio would be greater than the "correct" values of C corresponding to the "effective" penetration, and would in turn result in

a greater computed permeability for the sand strata than actually would exist.

27. Another tendency revealed by the test results is an increase in the coefficient of permeability with the radial distance from the well. At distances from the well near or exceeding the radius of influence, the drawdown curve begins to deviate from its parabolic shape and blends into the ground-water table. Therefore, at the greater radial distances, the Thiem formula given in paragraph 23 is not applicable. Computations using the observed heads at radial distances approximately equal to the radius of influence in conjunction with piezometric heads within the radius of influence will give erroneously high permeabilities. The values listed in the last three columns of tables 1 and 2 were not included in the averages given in table 3 since the radii of influence were less than 150 to 200 ft (see plates 7-9). It will be noted in table 1 that, for the 30 and 53 per cent penetration tests at Commerce Landing, the coefficients of permeability are quite high for the radii at the greater distances from the well.

28. It is pointed out that in the design of a relief well system the permeability used in computing well flow for any given pressure reduction should be the average permeability of the entire pervious stratum as determined by a 100 per cent penetration pumping test or an average of laboratory tests made on samples for the full depth of the pervious stratum.

Conclusions

29. The field coefficients of permeability obtained are believed

to be reliable, especially at the greater depths of penetration of the sand stratum where outside influences due to vertical flow and variations in the coarseness of the materials in the pervious stratum are not so important. It appears that a working permeability coefficient of about 700×10^{-4} cm per sec might be chosen from the results of the Commerce Landing tests and about 600×10^{-4} cm per sec from the results of the Wilson Point tests.

30. In general, the rates of pumping and the resultant drawdowns were less than desired. Only the coefficients of permeability obtained from radii within 200 ft of the test wells are considered reliable for the drawdowns obtained in these tests.

31. There is a fairly good agreement between the coefficients of permeability obtained from the field pumping tests and the permeabilities obtained from the empirical curve on plate 11, particularly at the greater per cent penetrations. Of course, permeabilities obtained by such empirical and laboratory methods are not as reliable as those obtained from pumping tests. However, there is an indication that for the areas tested the laboratory values as shown by plate 11 can be used quantitatively with considerable assurance that no large errors are involved.

32. Although the test well at Trotters had been drilled it was judged unnecessary to make the test after reviewing the results of the tests at Commerce Landing and Wilson Point. This conclusion was based on the fact that the results from the latter two sites showed a relatively small range in permeability values and that the foundation sand at Trotters was known to be intermediate between that of Commerce Landing and Wilson Point.

Table 1

FIELD PERMEABILITY TEST RESULTS -- COMMERCE LANDING

100% Penetration; Pumping Rate 294 gpm; Drawdown at Well 2.9 Ft

Well No.	r2-25 ft	r3-50 ft	r4-75 ft	r5-100 ft	r6-175 ft	r7-275 ft
r3- 50 ft	594	---	---	---	---	---
r4- 75 ft	613	637	---	---	---	---
r5-100 ft	645	652	679	---	---	---
r6-175 ft	635	657	666	657	---	---
r7-275 ft	676	713	746	683	945	---
r8-375 ft	700	744	777	802	952	975

74.4% Penetration; Pumping Rate 393 gpm; Drawdown at Well 3.3 Ft

Well No.	r2-25 ft	r3-50 ft	r4-75 ft	r5-100 ft	r6-175 ft	r7-275 ft
r3- 50 ft	674	---	---	----	----	----
r4- 75 ft	695	745	---	----	----	----
r5-100 ft	716	768	817	----	----	----
r6-175 ft	795	885	970	1085	----	----
r7-275 ft	875	997	1120	1252	1560	----
r8-375 ft	915	1042	1160	1280	1470	1374

53.0% Penetration; Pumping Rate 415 gpm; Drawdown at Well 3.8 Ft

Well No.	r2-25 ft	r3-50 ft	r4-75 ft	r5-100 ft	r6-175 ft	r7-275 ft
r3- 50 ft	860	----	---	----	----	----
r4- 75 ft	905	1000	---	----	----	----
r5-100 ft	881	910	805	----	----	----
r6-175 ft	960	1030	1040	1230	----	----
r7-275 ft	1066	1190	1265	1510	2100	----
r8-375 ft	1110	1240	1320	1535	1870	1620

39.6% Penetration; Pumping Rate 135 gpm; Drawdown at Well 2.9 Ft

Well	r2-25 ft	r3-50 ft	r4-75 ft	r5-100 ft	r6-175 ft	r7-275 ft
r3- 50 ft	792	---	---	----	----	----
r4- 75 ft	800	805	---	----	----	----
r5-100 ft	792	797	776	----	----	----
r6-175 ft	897	972	1070	1340	----	----
r7-275 ft	1037	1190	1402	1825	3280	----
r8-375 ft	1132	1320	1580	2050	3332	3380

Top stratum thickness = 9 ft
Pervious layer thickness = 181 ft
Average depth to water table at beginning of test (100% penetration) = 21 ft
Average depth to water table at beginning of test (75, 50, 25% penetration) = 22 ft
r = radius in ft.
Coefficients of permeability in cm/sec x 10^{-4} computed by Thiem's formula for various combinations of the average of observations on four lines of piezometers radial to test well.

Table 2

FIELD PERMEABILITY TEST RESULTS -- WILSON POINT

100% Penetration; Pumping Rate 300 gpm; Drawdown at Well 3.15 Ft

Well No.	r2-25 ft	r3-50 ft	r4-75 ft	r5-125 ft	r6-175 ft	r7-275 ft
r3- 50 ft	484	---	---	---	---	----
r4- 75 ft	477	467	---	---	---	----
r5-125 ft	494	503	535	---	---	----
r6-175 ft	501	511	530	530	---	----
r7-275 ft	542	573	615	682	856	----
r8-525 ft	606	651	710	805	953	1020

76.4% Penetration; Pumping Rate 295 gpm; Drawdown at Well 3.55 Ft

Well No.	r2-25 ft	r3-50 ft	r4-75 ft	r5-125 ft	r6-175 ft	r7-275 ft
r3- 50 ft	503	---	---	---	---	----
r4- 75 ft	517	547	---	---	---	----
r5-125 ft	580	656	780	---	---	----
r6-175 ft	615	697	809	845	---	----
r7-275 ft	650	742	840	875	900	----
r8-525 ft	719	825	974	976	1026	1139

71.2% Penetration; Pumping Rate 308 gpm; Drawdown at Well 3.75 Ft

Well No.	r2-25 ft	r3-50 ft	r4-75 ft	r5-125 ft	r6-175 ft	r7-275 ft
r3- 50 ft	550	---	---	---	---	---
r4- 75 ft	594	687	---	---	---	---
r5-125 ft	628	705	723	---	---	---
r6-175 ft	670	767	811	998	---	---
r7-275 ft	718	822	877	1010	1030	---
r8-525 ft	757	857	900	990	985	960

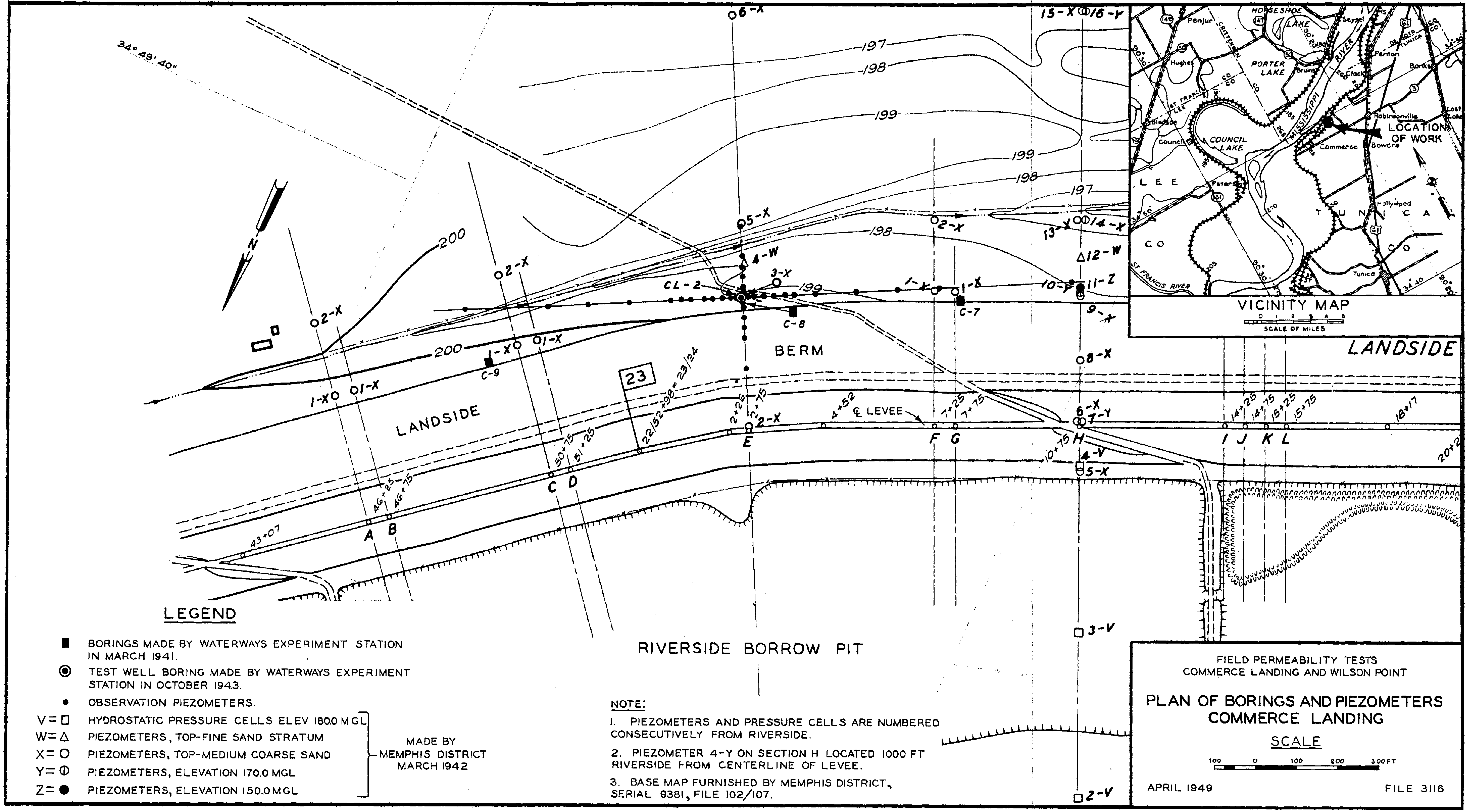
Top stratum thickness = 12 ft
Pervious layer thickness = 167 ft
Average depth to water table at beginning of test = 20 ft
r = radius in ft
Coefficients of permeability in cm/sec x 10^{-4} computed by Thiem's formula for various combinations of the average of observations on four lines of piezometers radial to test well.

Table 3

AVERAGE PERMEABILITIES -- FIELD AND LABORATORY

Commerce Landing			Wilson Point		
Per Cent Penetration	Field k^a	Laboratory k^c	Per Cent Penetration	Field k^b	Laboratory k^c
30.6	1024	336	30	---	307
53.0	1039	500	50	---	260
74.4	878	595	71.2	738	655
100.0			76.4	697	675
			100.0	547	680

[a] Average of first 3 columns of table 1.
[b] Average of first 3 columns of table 2.
[c] Average permeabilities within depth of penetration indicated from D_{10} (see plate 11).
Coefficients of permeability in 10^{-4} cm per sec.



LEGEND

- ■ BORINGS MADE BY WATERWAYS EXPERIMENT STATION IN MARCH 1941.
- ◉ TEST WELL BORING MADE BY WATERWAYS EXPERIMENT STATION IN OCTOBER 1943.
- • OBSERVATION PIEZOMETERS.

V= □	HYDROSTATIC PRESSURE CELLS ELEV 180.0 MGL	MADE BY MEMPHIS DISTRICT MARCH 1942
W= △	PIEZOMETERS, TOP-FINE SAND STRATUM	
X= ○	PIEZOMETERS, TOP-MEDIUM COARSE SAND	
Y= ⦶	PIEZOMETERS, ELEVATION 170.0 MGL	
Z= ●	PIEZOMETERS, ELEVATION 150.0 MGL	

NOTE:

1. PIEZOMETERS AND PRESSURE CELLS ARE NUMBERED CONSECUTIVELY FROM RIVERSIDE.
2. PIEZOMETER 4-Y ON SECTION H LOCATED 1000 FT RIVERSIDE FROM CENTERLINE OF LEVEE.
3. BASE MAP FURNISHED BY MEMPHIS DISTRICT, SERIAL 9381, FILE 102/107.

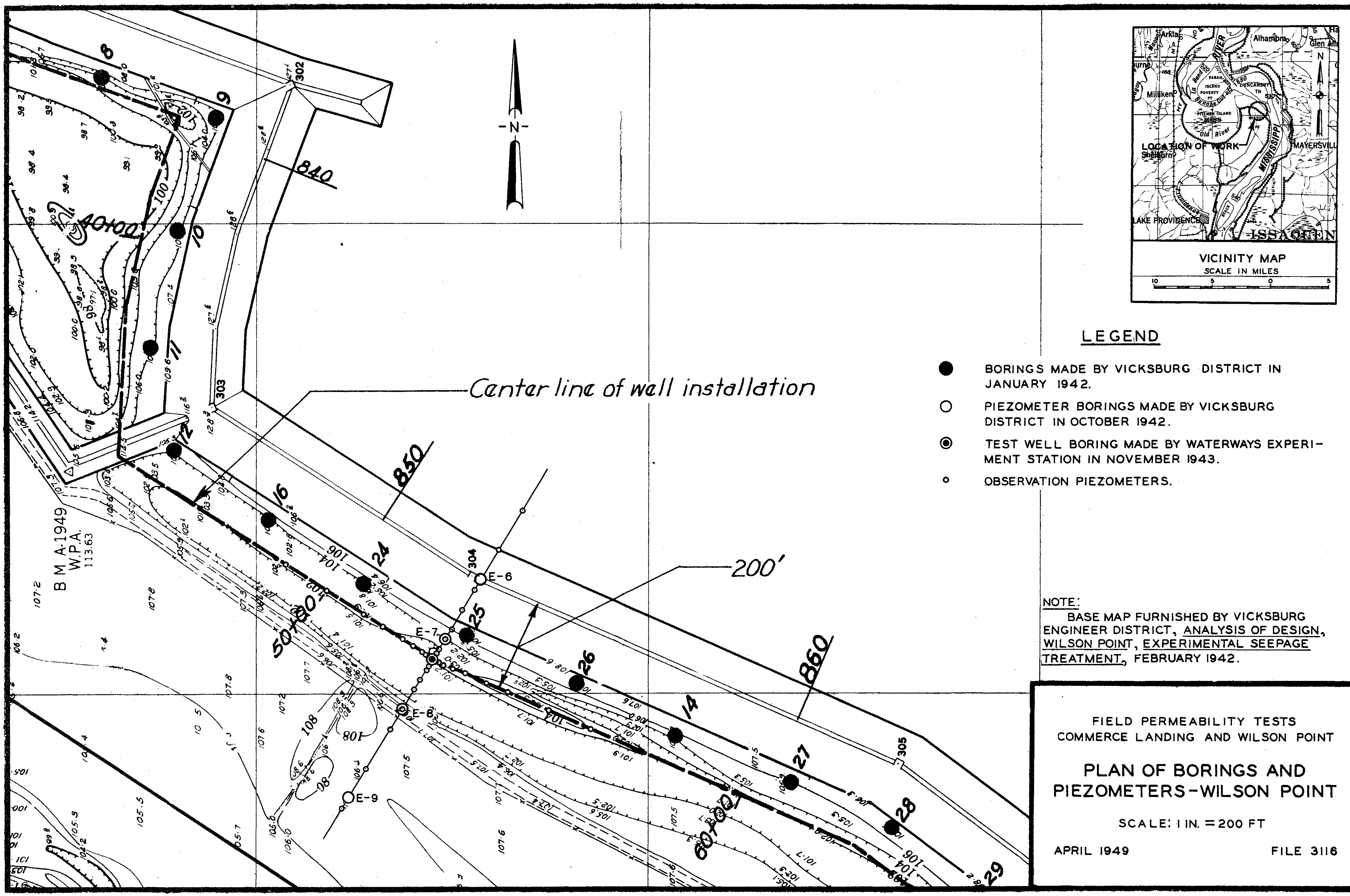
FIELD PERMEABILITY TESTS
COMMERCE LANDING AND WILSON POINT

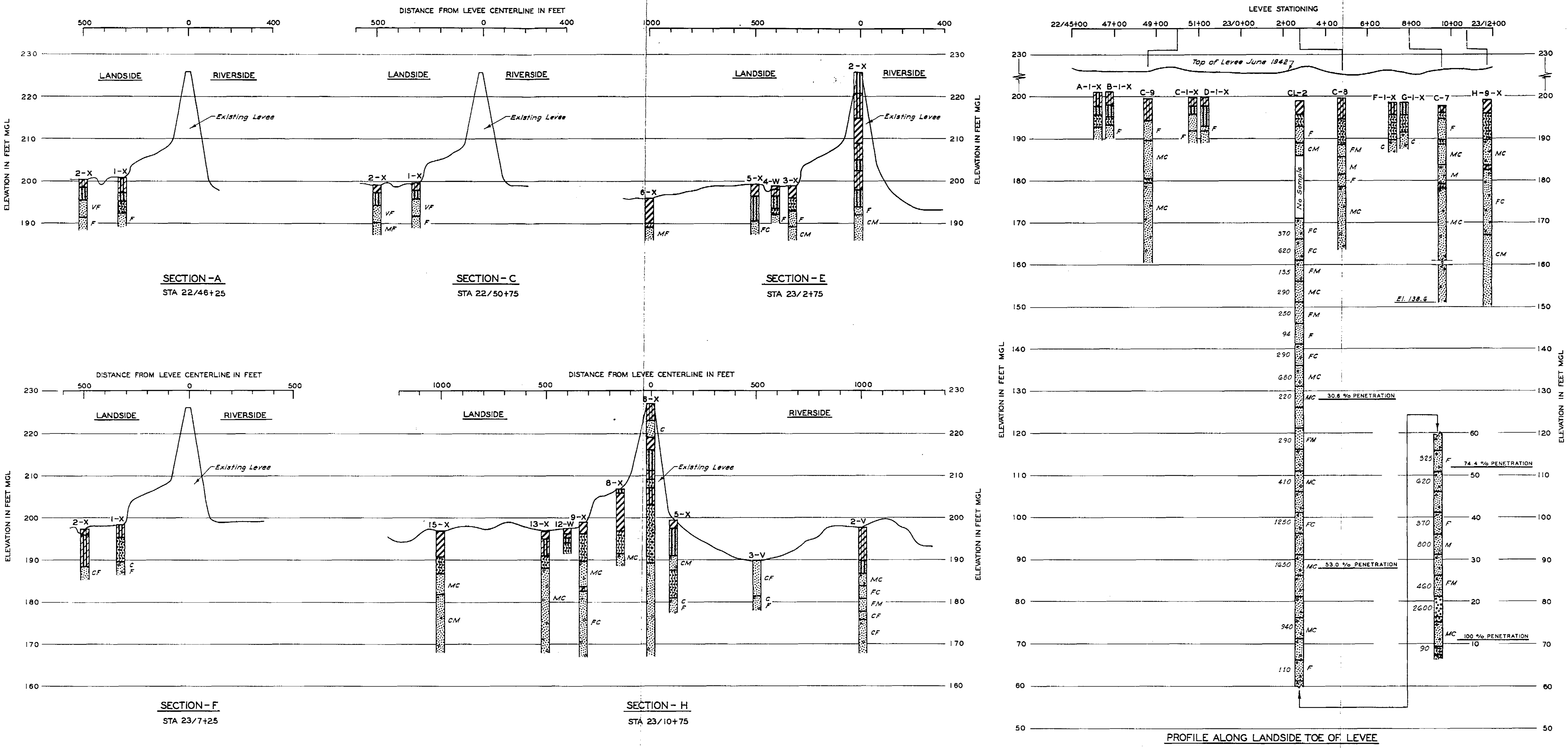
PLAN OF BORINGS AND PIEZOMETERS COMMERCE LANDING

SCALE

100 0 100 200 300 FT

APRIL 1949 FILE 3116


Center line of wall installation
200'
840
850
860
B M A-1949
W.P.A.
113.63
E-6
E-7
E-8
E-9
50+00
60+00
302
303
304
305
N
VICINITY MAP
SCALE IN MILES
LOCATION OF WORK
LAKE PROVIDENCE
MAYERSVILLE
MISSISSIPPI
Milliken
Alhambra
LEGEND
BORINGS MADE BY VICKSBURG DISTRICT IN JANUARY 1942.
PIEZOMETER BORINGS MADE BY VICKSBURG DISTRICT IN OCTOBER 1942.
TEST WELL BORING MADE BY WATERWAYS EXPERIMENT STATION IN NOVEMBER 1943.
OBSERVATION PIEZOMETERS.
NOTE:
BASE MAP FURNISHED BY VICKSBURG ENGINEER DISTRICT, ANALYSIS OF DESIGN, WILSON POINT, EXPERIMENTAL SEEPAGE TREATMENT, FEBRUARY 1942.
FIELD PERMEABILITY TESTS
COMMERCE LANDING AND WILSON POINT
PLAN OF BORINGS AND PIEZOMETERS-WILSON POINT
SCALE: 1 IN. = 200 FT
APRIL 1949
FILE 3116



LEGEND

- CLAY
- SILTY CLAY
- CLAY SILT
- SANDY SILT
- SILT
- CLAY SAND
- SILTY SAND
- SAND
- GRAVEL

VF VERY FINE SAND
F FINE SAND
M MEDIUM SAND
C COARSE SAND

NOTES:

1. BORINGS C-7, C-8, AND C-9 WERE MADE IN MARCH 1941 BY WATERWAYS EXPERIMENT STATION.

2. BORING CL-2 FOR TEST WELL WAS MADE IN OCTOBER 1943 BY WATERWAYS EXPERIMENT STATION. UPPER 13 FT OF LOG TAKEN FROM PIEZOMETER BORING E-3-X.

3. ALL OTHER BORINGS WERE MADE IN MARCH 1942 BY MEMPHIS DISTRICT.

4. NUMBERS TO LEFT OF BORING CL-2 ARE COEFFICIENTS OF PERMEABILITY IN 10^{-4} CM PER SECOND AS DETERMINED FROM CURVE ON PLATE 11.

FIELD PERMEABILITY TESTS
COMMERCE LANDING AND WILSON POINT

BORING LOGS
COMMERCE LANDING

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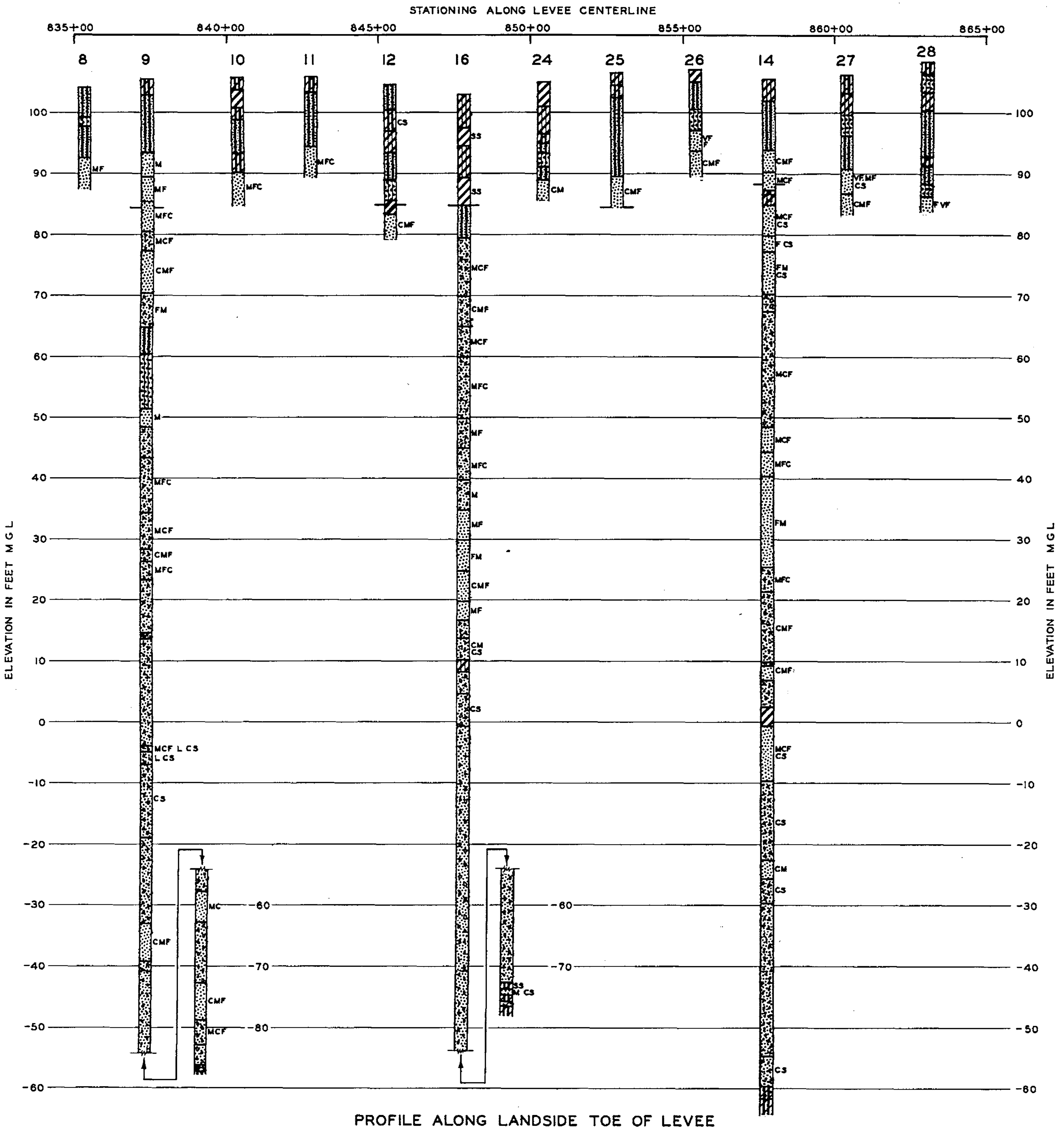
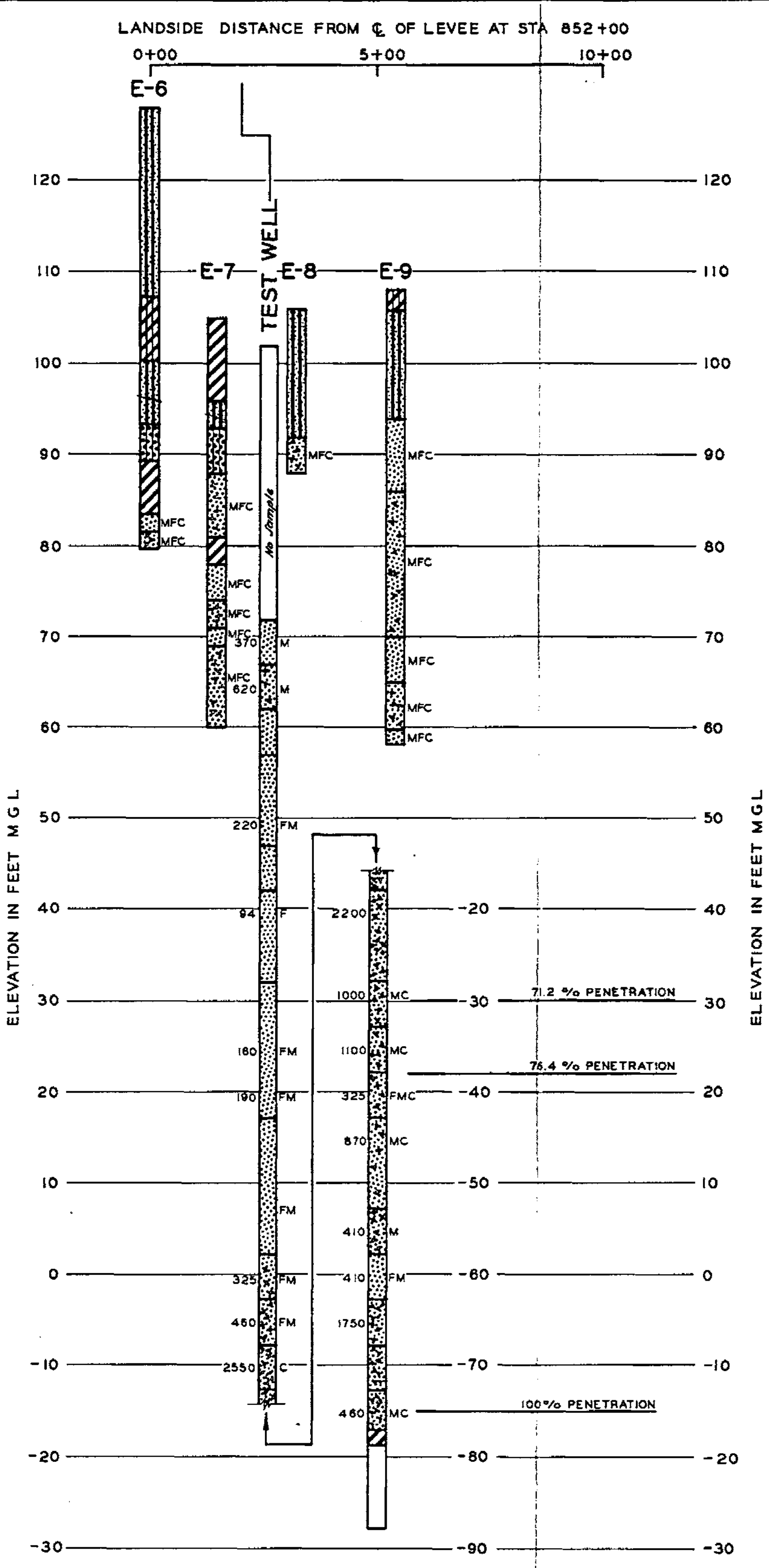


PROFILE ALONG LANDSIDE TOE OF LEVEE

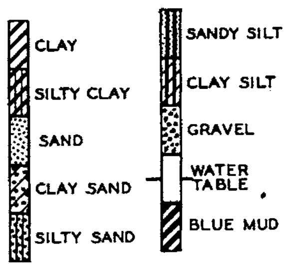


SECTION AT STA 852+00

NOTES:

1. BORINGS 8 THRU 12, 14, 16, AND 24 THRU 27 MADE BY VICKSBURG DISTRICT IN JANUARY 1942.
2. BORINGS E-6, E-7, E-8, AND E-9 ARE PIEZOMETER INSTALLATIONS MADE BY THE VICKSBURG DISTRICT IN OCTOBER 1942.
3. TEST WELL BORING WAS MADE IN NOVEMBER 1943 BY THE WATERWAYS EXPERIMENT STATION.
4. NUMBERS TO LEFT OF TEST WELL BORING ARE COEFFICIENTS OF PERMEABILITY IN 10^{-4} CM PER SEC AS TAKEN FROM CURVE ON PLATE 11.

LEGEND

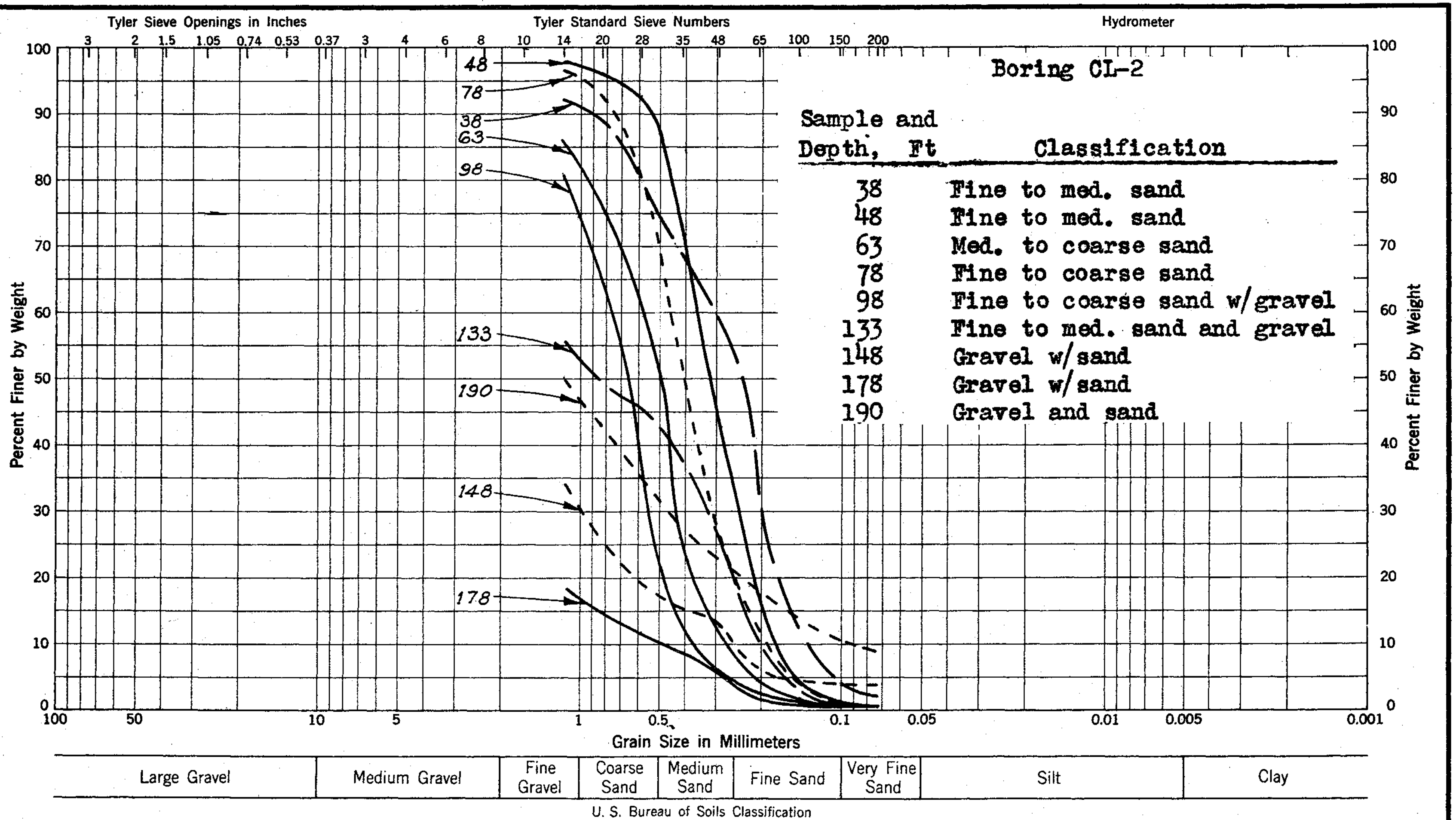


F FINE SAND
VF VERY FINE SAND
M MEDIUM SAND
C COARSE SAND
CS CLAY STRATA
SS SAND STRATA
L LIGNITIC

FIELD PERMEABILITY TESTS
COMMERCE LANDING AND WILSON POINT

BORING LOGS
WILSON POINT

APRIL 1949 FILE 3116

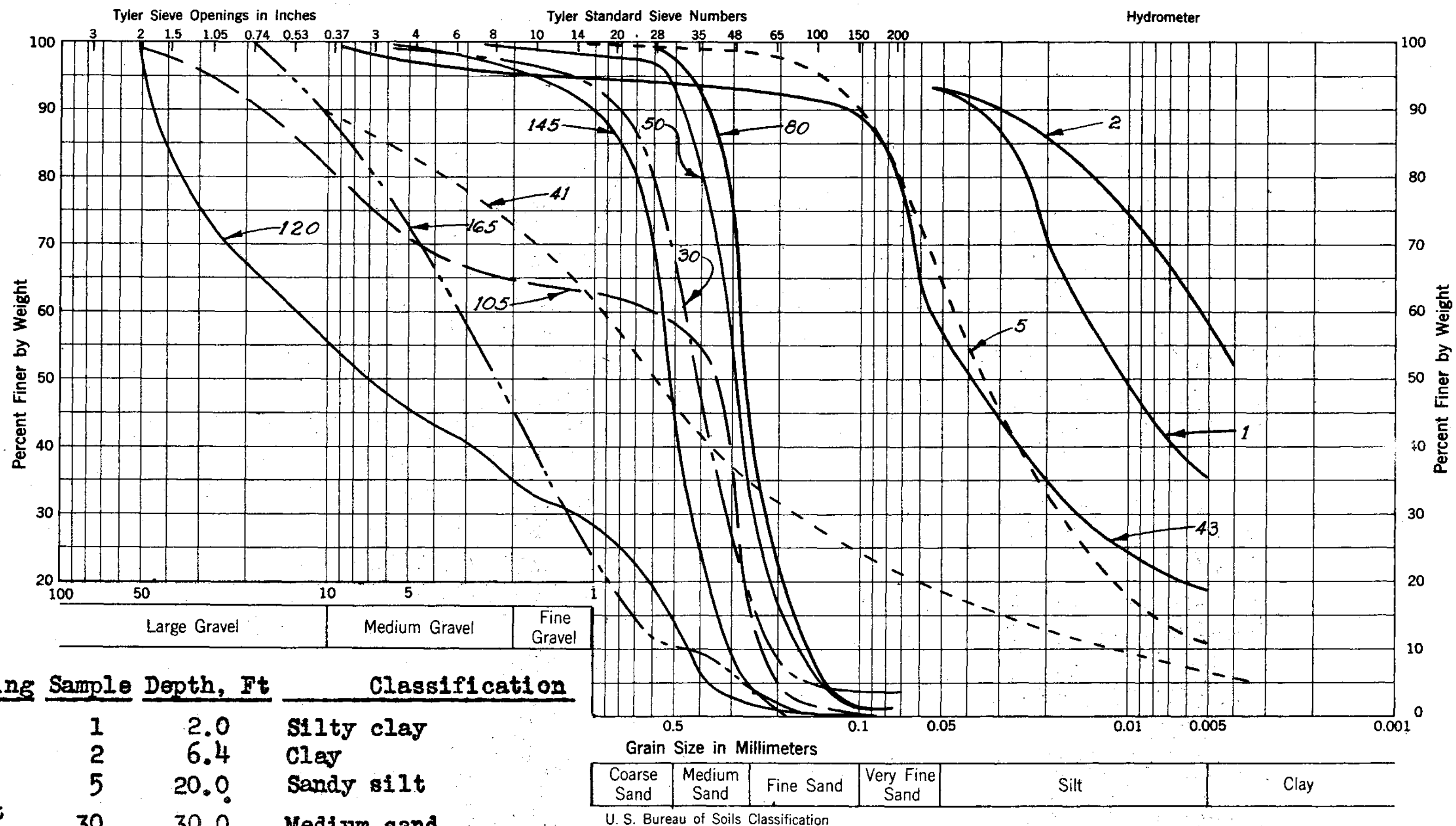


Field Permeability Tests
Commerce Landing and Wilson Point

GRAIN SIZE CURVES
Commerce Landing

May 1949 File 3116

PLATE 5



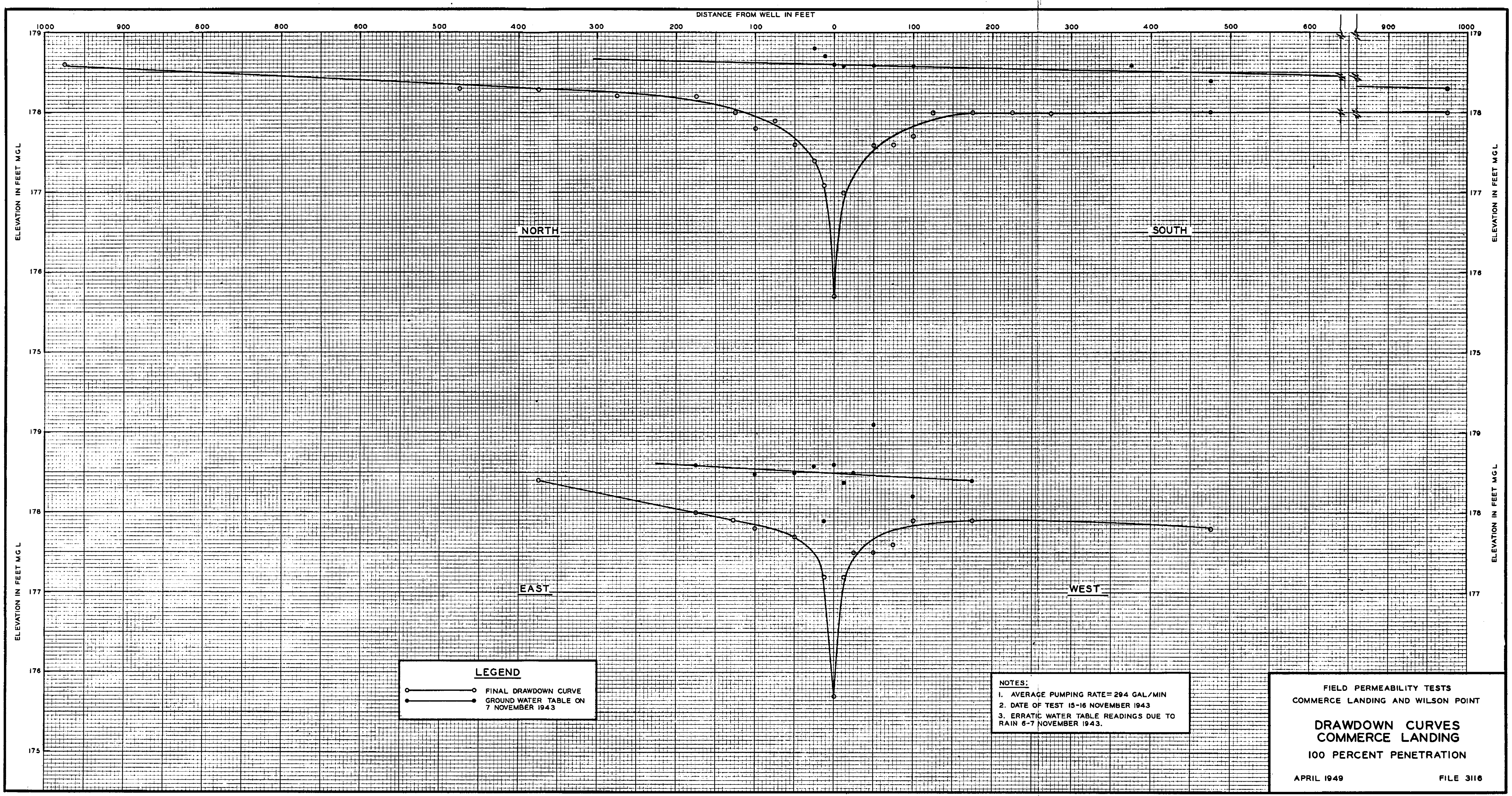
Boring	Sample	Depth, Ft	Classification
16	1	2.0	Silty clay
16	2	6.4	Clay
16	5	20.0	Sandy silt
Test well	30	30.0	Medium sand
"	50	50.0	Fine to med. sand
"	80	80.0	Fine to med. sand
"	105	105.0	Fine to med. sand w/gravel
"	120	120.0	Gravel w/sand
"	145	145.0	Med. and coarse sand
"	165	165.0	Gravel w/sand
16	41	177.0	Sand w/gravel
16	43	179.0	Clay sand

Field Permeability Tests
Commerce Landing and Wilson Point

GRAIN SIZE CURVES
Wilson Point

May 1949 File 3116

PLATE 6



DISTANCE FROM WELL IN FEET
ELEVATION IN FEET M G L
NORTH
SOUTH
EAST
WEST
LEGEND
FINAL DRAWDOWN CURVE
GROUND WATER TABLE ON 7 NOVEMBER 1943
NOTES:
1. AVERAGE PUMPING RATE = 294 GAL/MIN
2. DATE OF TEST 15-16 NOVEMBER 1943
3. ERRATIC WATER TABLE READINGS DUE TO RAIN 6-7 NOVEMBER 1943.
FIELD PERMEABILITY TESTS
COMMERCE LANDING AND WILSON POINT
DRAWDOWN CURVES
COMMERCE LANDING
100 PERCENT PENETRATION
APRIL 1949
FILE 3116

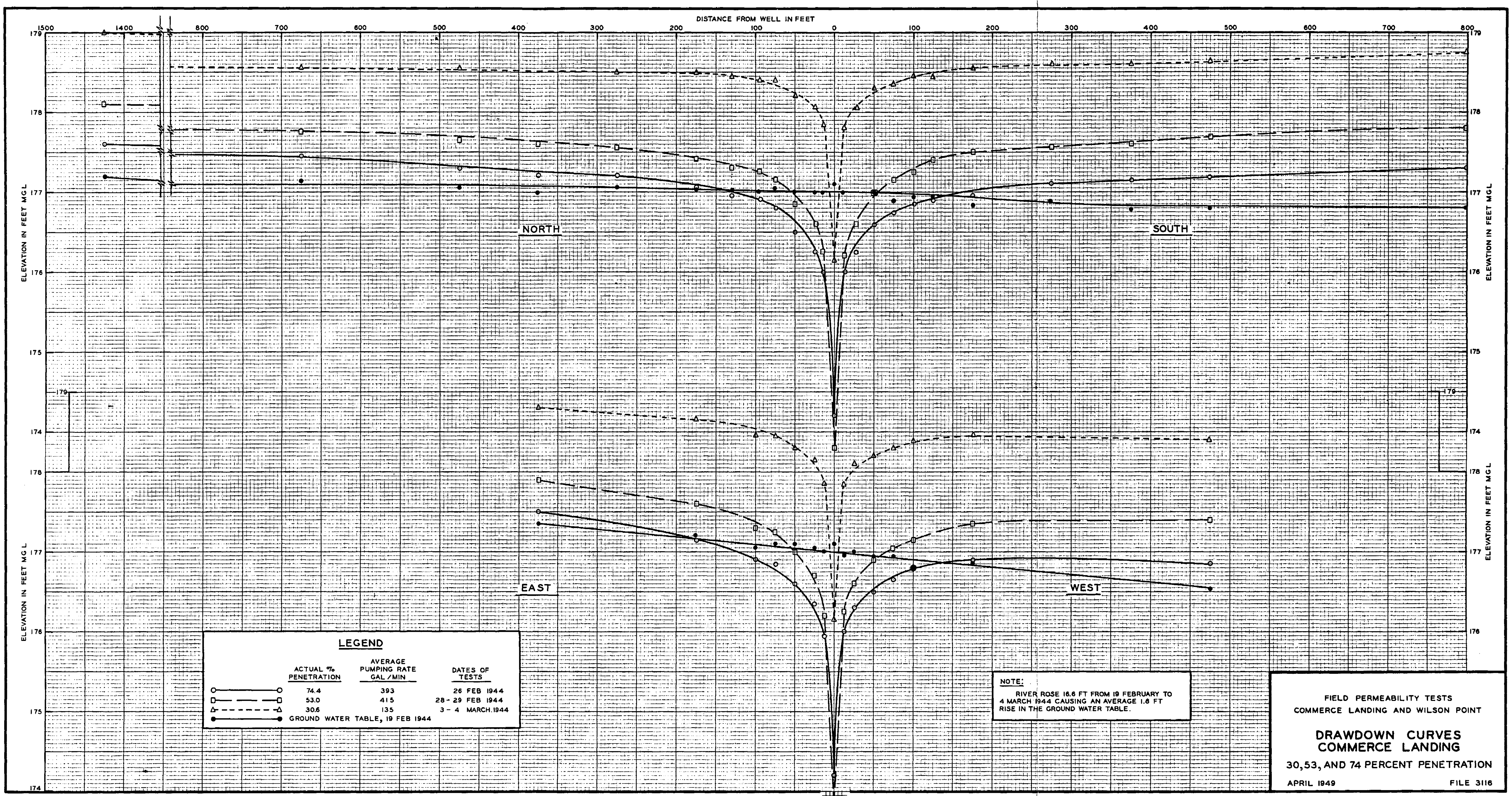

DISTANCE FROM WELL IN FEET
ELEVATION IN FEET MGL
NORTH
SOUTH
EAST
WEST
LEGEND
ACTUAL % PENETRATION
AVERAGE PUMPING RATE GAL/MIN
DATES OF TESTS
74.4 393 26 FEB 1944
53.0 415 28-29 FEB 1944
30.6 135 3-4 MARCH 1944
GROUND WATER TABLE, 19 FEB 1944
NOTE:
RIVER ROSE 16.6 FT FROM 19 FEBRUARY TO 4 MARCH 1944 CAUSING AN AVERAGE 1.6 FT RISE IN THE GROUND WATER TABLE.
FIELD PERMEABILITY TESTS
COMMERCE LANDING AND WILSON POINT
DRAWDOWN CURVES
COMMERCE LANDING
30, 53, AND 74 PERCENT PENETRATION
APRIL 1949
FILE 3116

PLATE 8

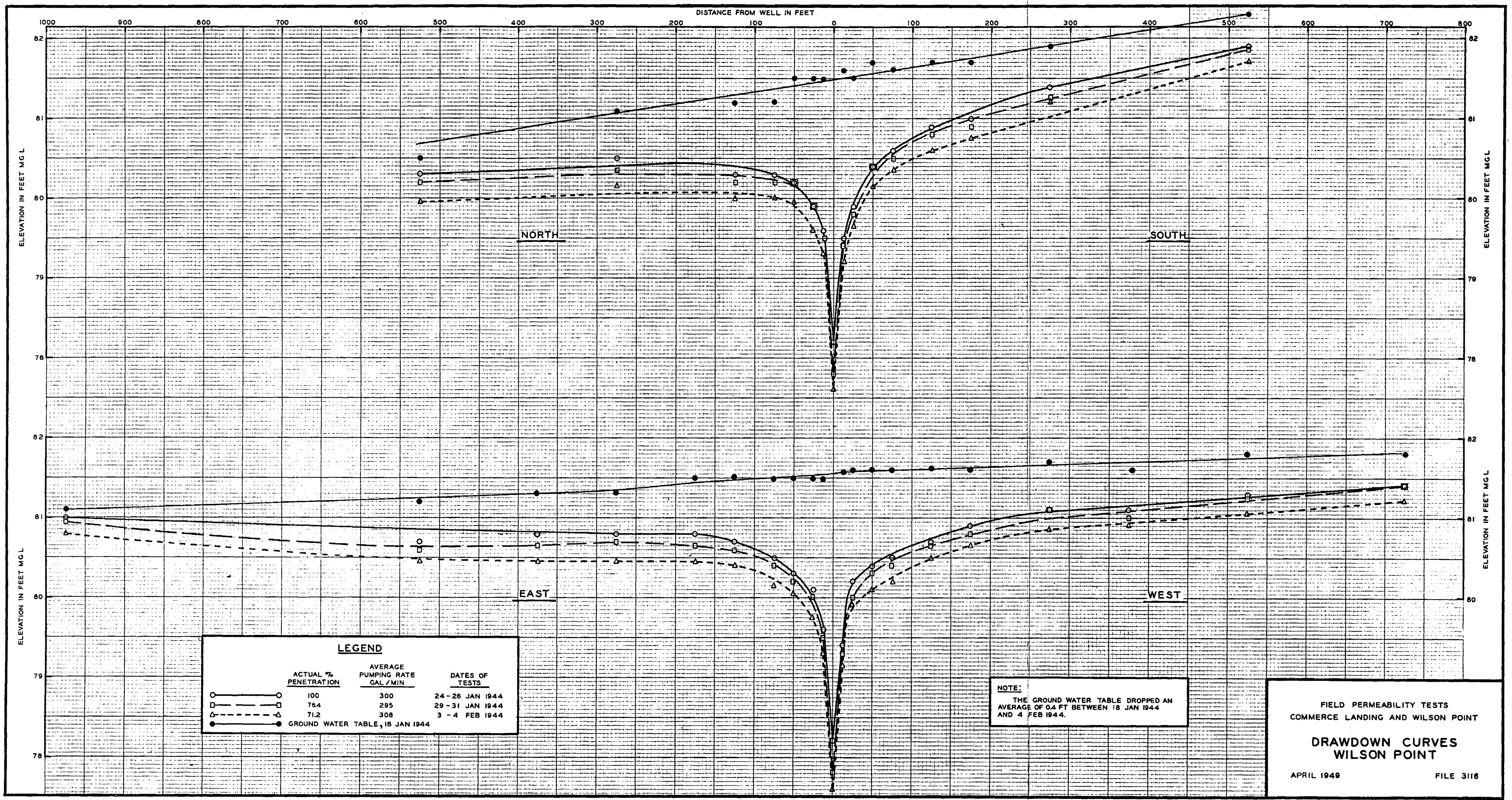
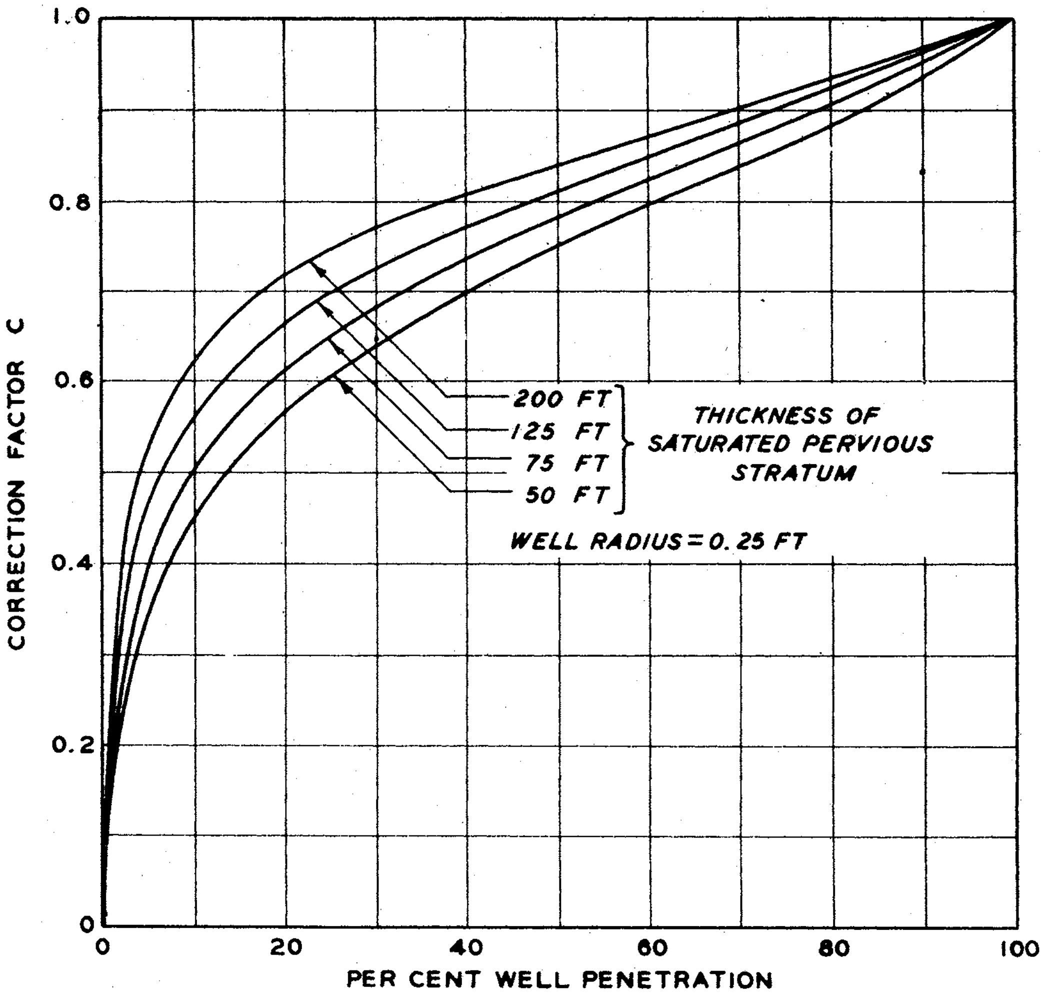

DISTANCE FROM WELL IN FEET
ELEVATION IN FEET MGL
NORTH
SOUTH
EAST
WEST
LEGEND
ACTUAL % PENETRATION
AVERAGE PUMPING RATE GAL/MIN
DATES OF TESTS
100 300 24-26 JAN 1944
76.4 295 29-31 JAN 1944
71.2 308 3-4 FEB 1944
GROUND WATER TABLE, 18 JAN 1944
NOTE:
THE GROUND WATER TABLE DROPPED AN AVERAGE OF 0.4 FT BETWEEN 18 JAN 1944 AND 4 FEB 1944.
FIELD PERMEABILITY TESTS
COMMERCE LANDING AND WILSON POINT
DRAWDOWN CURVES
WILSON POINT
APRIL 1949
FILE 3116

PLATE 9



NOTES:

1. THICKNESS OF SATURATED PERVIOUS STRATUM AT COMMERCE LANDING WAS 169 FT; AT WILSON POINT 159 FT.

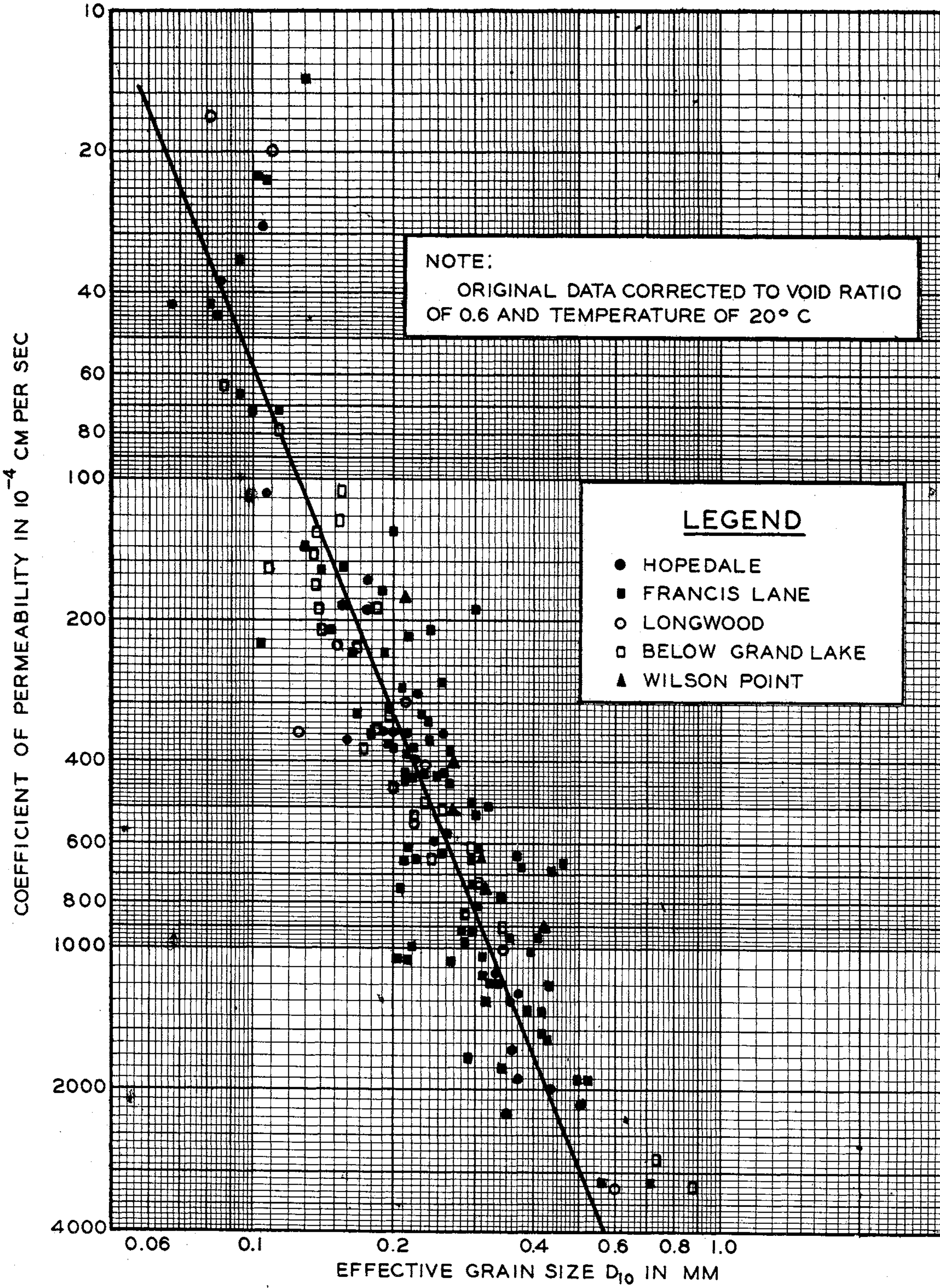
2. CURVES FROM MUSKAT, MORRIS, THE FLOW OF HOMOGENEOUS FLUIDS THROUGH POROUS MEDIA, Mc GRAW-HILL BOOK CO. NEW YORK, 1937. P 96.

3. CURVES ARE FOR HOMOGENEOUS ISOTROPIC PERVIOUS STRATA.

FIELD PERMEABILITY TESTS
COMMERCE LANDING AND WILSON POINT

CORRECTION FACTORS

JUNE 1949 FILE 3116



FIELD PERMEABILITY TESTS
COMMERCE LANDING AND WILSON POINT

COEFFICIENT OF PERMEABILITY VS EFFECTIVE GRAIN SIZE

APRIL 1949 FILE 3116

PLATE 11